Considerations for Ecosystem Restoration in Currituck Sound

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Discussion Topics

- ✓ **Planning Consideration for Coastal Restoration**

- ✓ **Ecosystem Restoration in Currituck Sound : An Acid Test**
  - **Expanded Contacts**
  - **Site Selection Consideration**
  - **Plant Considerations**
  - **Modeling**
  - **Logistic Consideration**

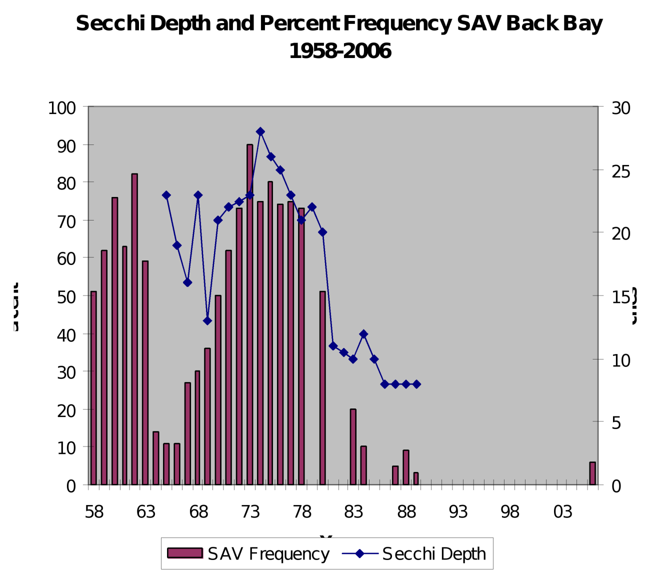
- ✓ **Example Projects in NC**

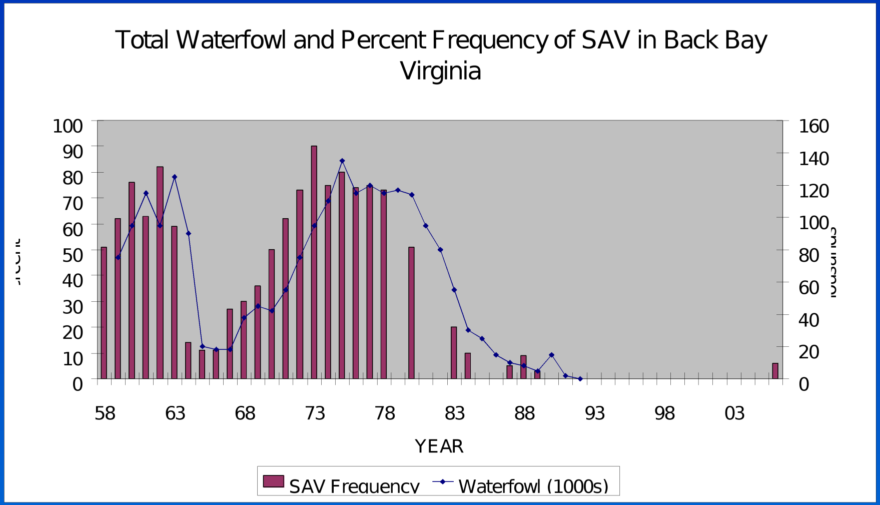
Restoration Planning Considerations

Identify Goals → Identify Sites → Appropriate Sp

- **Nutrient Removal**
- **Sediment Toxicant Removal**
- **Aquatic Diversity/Abundance**
- **Shoreline Stabilizati**
- **Aesthetics**
- **Wildlife Habitat**

SAV Ecological Relationships





SAV responds to changes in water clarity - biofeedback

Data from Settle and Schwab, VDGIF 1990 & ECSU 2007

Waterfowl respond to food availability

Expanded SAV Contacts

- **High Salinity SAV, NMFS SAV :** Dr**.** Mark S. Fonseca, NOAA Fisheries
- **Low Salinity Submersed Grasses**: Dr. Kenneth A. Moore VIMS
- ✓ **Chesapeake Bay Restoration,** Drs. Deborah Shafer (ERDC), Steve Ailstock (AACC) & Dan Murphy (USFWS)
- **Optical Model:** Jud Kenworthy NOAA
- ✓ **Back Bay SAV study:** Cindy Kane USFWS
- *Rhizoctonia* **fungus:** Drs**.** Marc A. Cubeta & Carl R. Crozier,. NC State, Judy Shearer ERDC, Jan Kohlmeyer UNC Institute of Marine Sciences
- ✓ **Wilson Bay SAV Restoration:** Pat Donavan-Potts City of Jacksonville
- **Potential State Wide SAV Propagation**: JP Mc Cain Sturgeon City, & Dr. Kimberly Jones, Brunswick Community College
- **SAV Field Conditions and Mapping:** Jill Paxson DWQ, Scott Chappell NCDMF
- **SAV Restoration, propagation of Ruppia:** Michael J. Durako, Professor UNCW
- ✓ **SAV Work Group (14 Members), APNEP, CHPP**

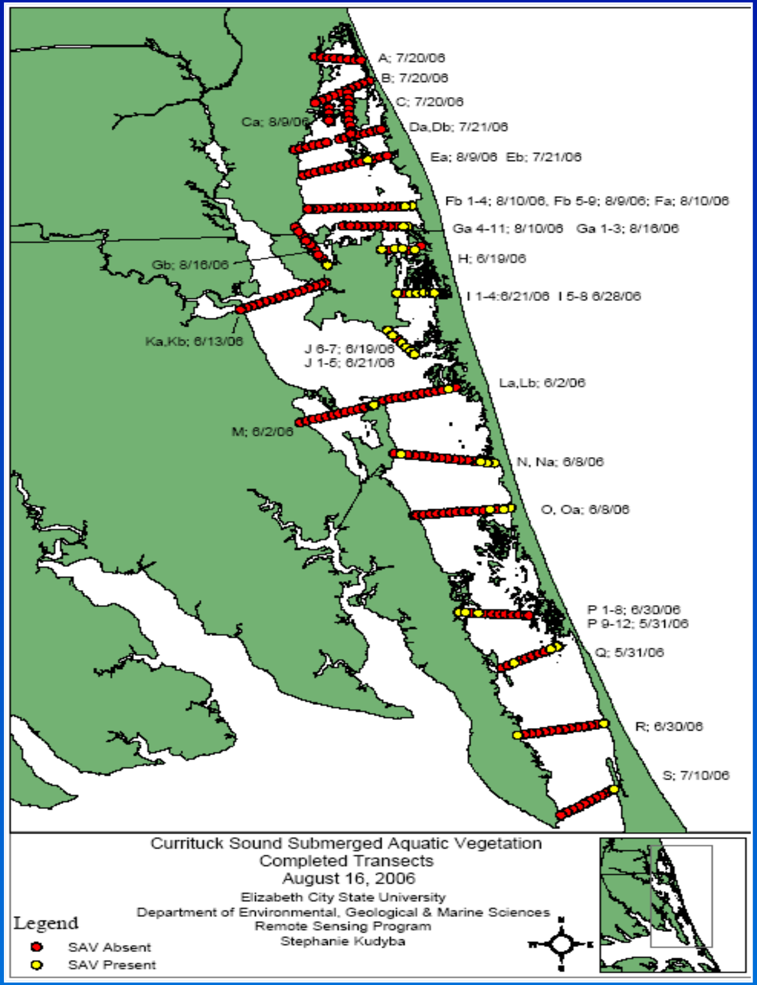
Considerations for Site Selection **Physical Conditions**

- **HYDROLIGY**
  - Non-tidal
  - Tidal (Lunar tide, or wind driven tide)

- **WATER QUALITY**
  - Salinity
  - Clarity, (TSS, Color, Chlorophyll)
  - Nutrients (Dissolved Inorganic Phosphorus and Nitrogen)

- **SOILS**
  - Muck Soils
  - Sandy soils

- **ENERGY REGEIME (High, Moderate, Low)**
  - Location relative to prevailing winds
  - Fetch
  - Bottom topography


A; 7/20/06
B; 7/20/06
C; 7/20/06
Ca; 8/9/06
Da,Db; 7/21/06
Ea; 8/9/06 Eb; 7/21/06
Fb 1-4; 8/10/06, Fb 5-9; 8/9/06; Fa; 8/10/06
Ga 4-11; 8/10/06   Ga 1-3; 8/16/06
Gb; 8/16/06
H; 6/19/06
I 1-4:6/21/06 I 5-8 6/28/06
Ka,Kb; 6/13/06
J 6-7; 6/19/06
J 1-5; 6/21/06
La,Lb; 6/2/06
M; 6/2/06
N, Na; 6/8/06
O, Oa; 6/8/06
P 1-8; 6/30/06
P 9-12; 5/31/06
Q; 5/31/06
R; 6/30/06
S; 7/10/06
Currituck Sound Submerged Aquatic Vegetation
Completed Transects
August 16, 2006
Elizabeth City State University
Department of Environmental, Geological & Marine Sciences
Remote Sensing Program
Stephanie Kudyba
Legend
SAV Absent
SAV Present

Considerations for Site Selection

- **HUMAN FACTORS**
  - **Adjacent Land Use**
  - **Storm water or Sewage Drainage**
  - **Shoreline Erosion Turbidity and Burial**
  - **Dredging of Navigation Channels**
  - **High Human Recreational Activities**
  - **Hydrologic Modifications**
    - Channels, locks
    - Flow Regulation (Dams)
    - Restrictions, (Bridges, Causeways, Dune Building)
    - Salt or fresh water discharge
- **BIOLOGICAL FACTORS**
  - **Waterfowl – Resident Geese**
  - **Carp**
  - **Nutria**
  - **Plant Fungus ?** *Rhizoctonia solaniia*

Other Considerations

- Infrequent Natural Events
  - Hurricanes
  - Droughts
  - Floods
  - Hard Winters

September 18, 2003
Hurricane
Isabel

WQ Modeling Scenarios

- ✓ Nutrient Loading
  - Point source
  - Impervious surfaces
  - Agriculture influences
- ✓ AIWW
  - Hydrologic effects
  - Discharge of Suspended Solids
  - Locks
- ✓ Salinity Intrusion & Suspended Solids
  - Historic inlets
  - Canal No. 2, A&C Canal
  - Wash over
  - Pumping into Back Bay
  - Blockages at the Narrows
  - Wind fetch effects
  - Rising sea levels
- Other
  - Changes to Roanoke River – Dams, Flows

Modeling Scenarios

Considered but not Selected

- ✓ Albemarle Sound Inputs
  - ▪ Dredging North Landing River
  - ▪ Channelization of Joyce Creek
- ✓ Other influences
  - ▪ Bridges – Roanoke Island, Outer Banks, Wright Bridge
  - ▪ Proposed Currituck Bridge
  - ▪ Croatan Sound restrictions
  - ▪ Dredging Oregon Inlet

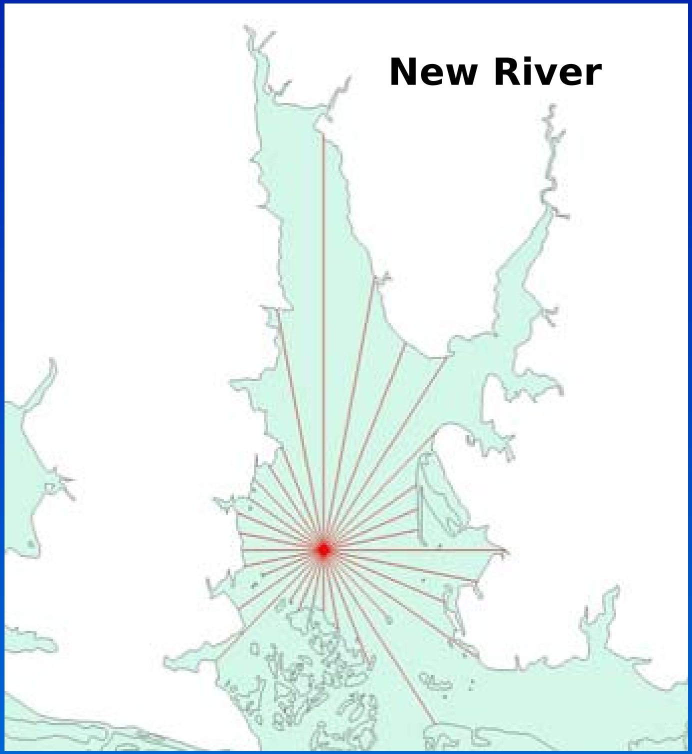
NOAA Tidally Corrected Optical Water Quality Model

- The amount of light reaching seagrass is the product of several factors
  - Epiphytes
  - Water depth
  - Turbidity.
    - **chlorophyll a,**
    - **suspended particulate matter (SPM)**
    - **colored dissolved organic matter (CDOM)**

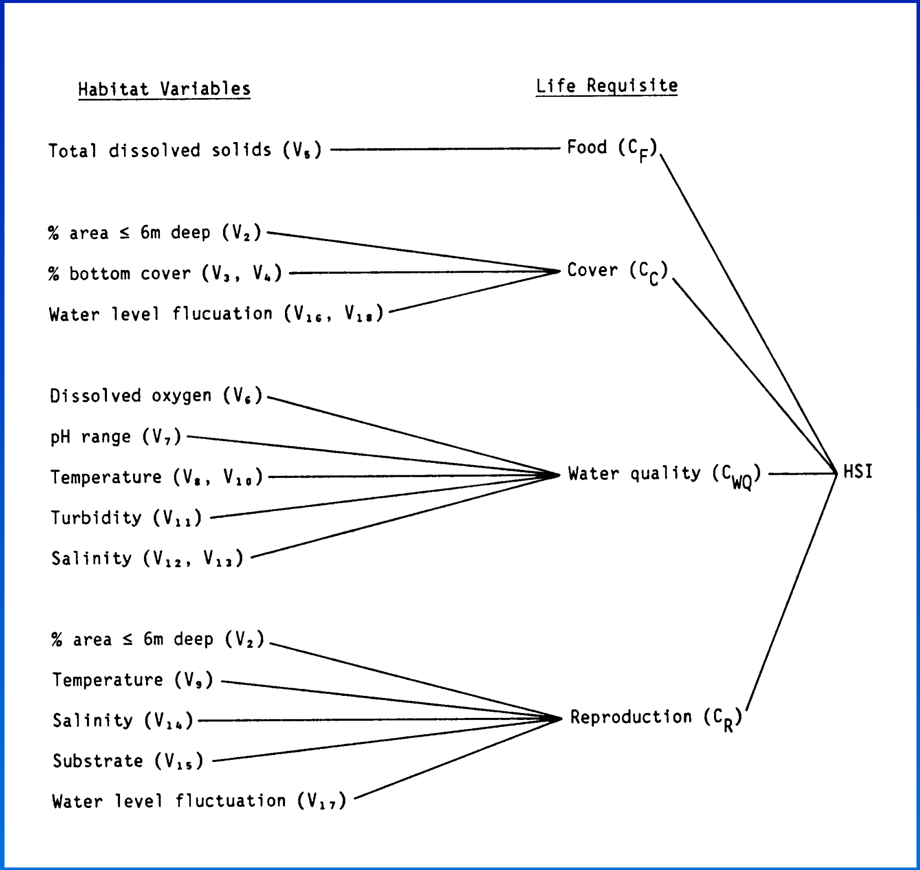
NCCOS WAVE EXPOSURE MODEL (WEMo)

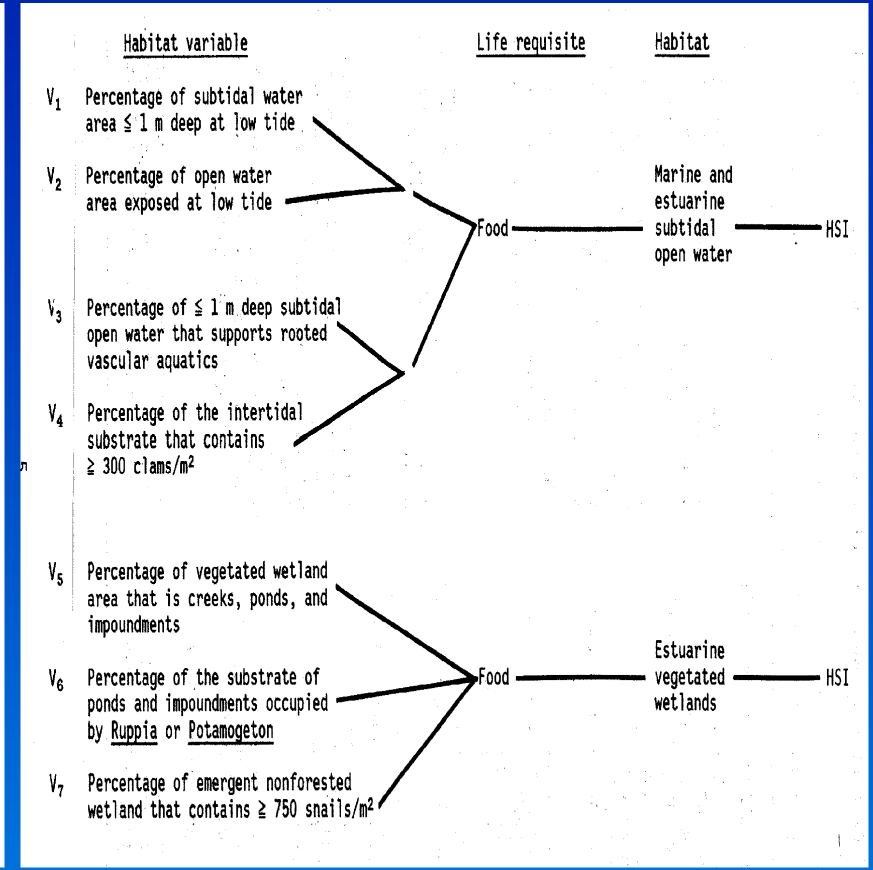
Relative Exposure Index (REI) for each of the major eight compass headings

- **Wind speed**
- **Frequency of wind**
- **Fetch**



Habitat Suitability Index Largemouth Bass & Black Duck


Habitat Variables
Life Requisite
Total dissolved solids (V_5)
Food (C_F)
% area ≤ 6m deep (V_2)
% bottom cover (V_3, V_4)
Water level flucuation (V_{16}, V_{18})
Cover (C_C)
Dissolved oxygen (V_6)
pH range (V_7)
Temperature (V_8, V_{10})
Turbidity (V_{11})
Salinity (V_{12}, V_{13})
Water quality (C_{WQ})
HSI
% area ≤ 6m deep (V_2)
Temperature (V_9)
Salinity (V_{14})
Substrate (V_{15})
Water level fluctuation (V_{17})
Reproduction (C_R)


Habitat variable
Life requisite
Habitat
V_1 Percentage of subtidal water area ≦ 1 m deep at low tide
V_2 Percentage of open water area exposed at low tide
V_3 Percentage of ≦ 1 m deep subtidal open water that supports rooted vascular aquatics
V_4 Percentage of the intertidal substrate that contains ≧ 300 clams/m²
Food
Marine and estuarine subtidal open water
HSI
V_5 Percentage of vegetated wetland area that is creeks, ponds, and impoundments
V_6 Percentage of the substrate of ponds and impoundments occupied by Ruppia or Potamogeton
V_7 Percentage of emergent nonforested wetland that contains ≧ 750 snails/m²
Food
Estuarine vegetated wetlands
HSI

Logistic Considerations

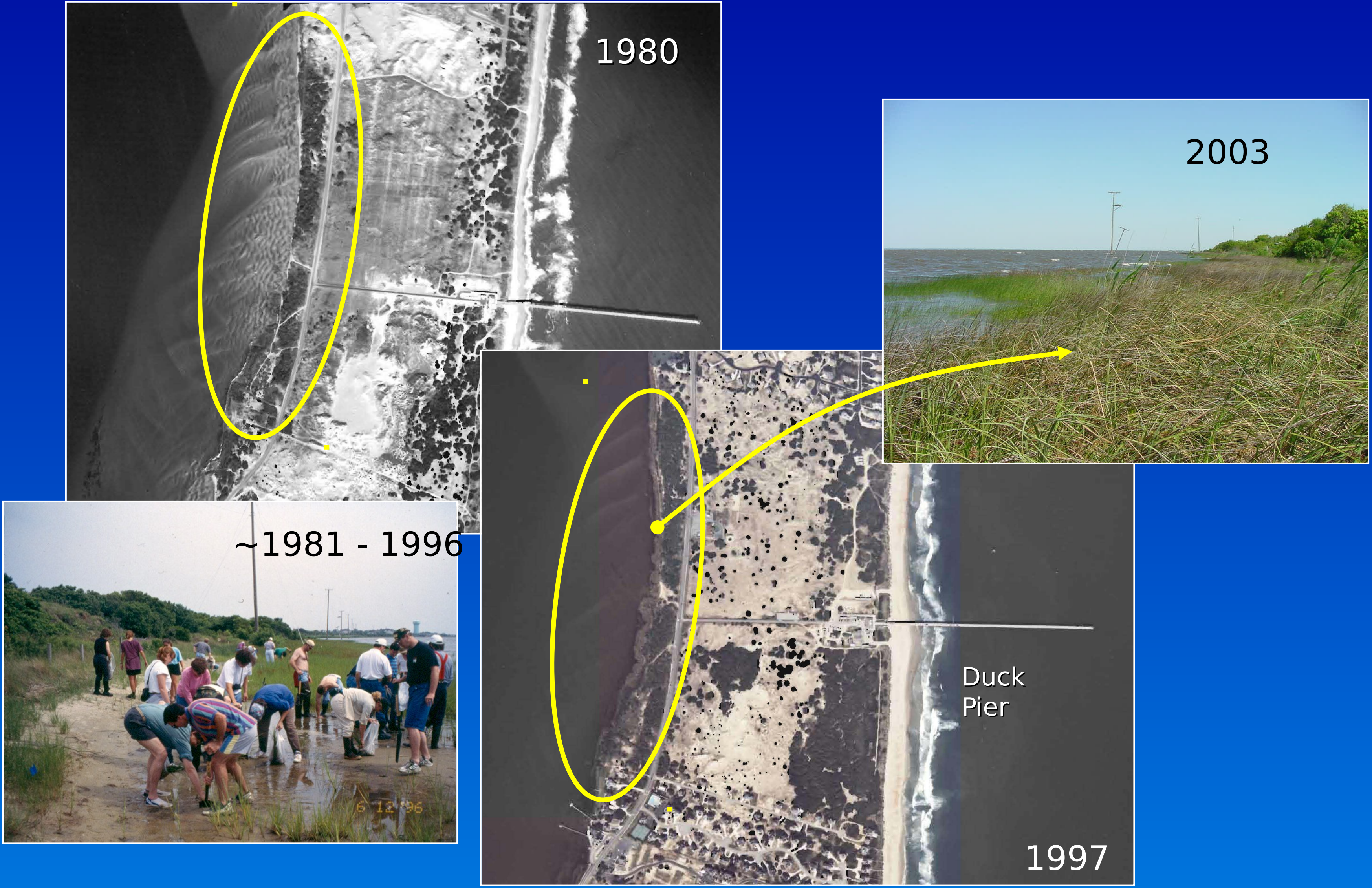
SAV RESTORATION OPTIONS

- Remove Stressors
  - Protective Structures
  - Hydrologic Modifications
  - Nutrient, or Sediment Reductions
  - Control Exotic Species

- Allow Natural Colonization
  - Not appropriate if exotic plants are a threat

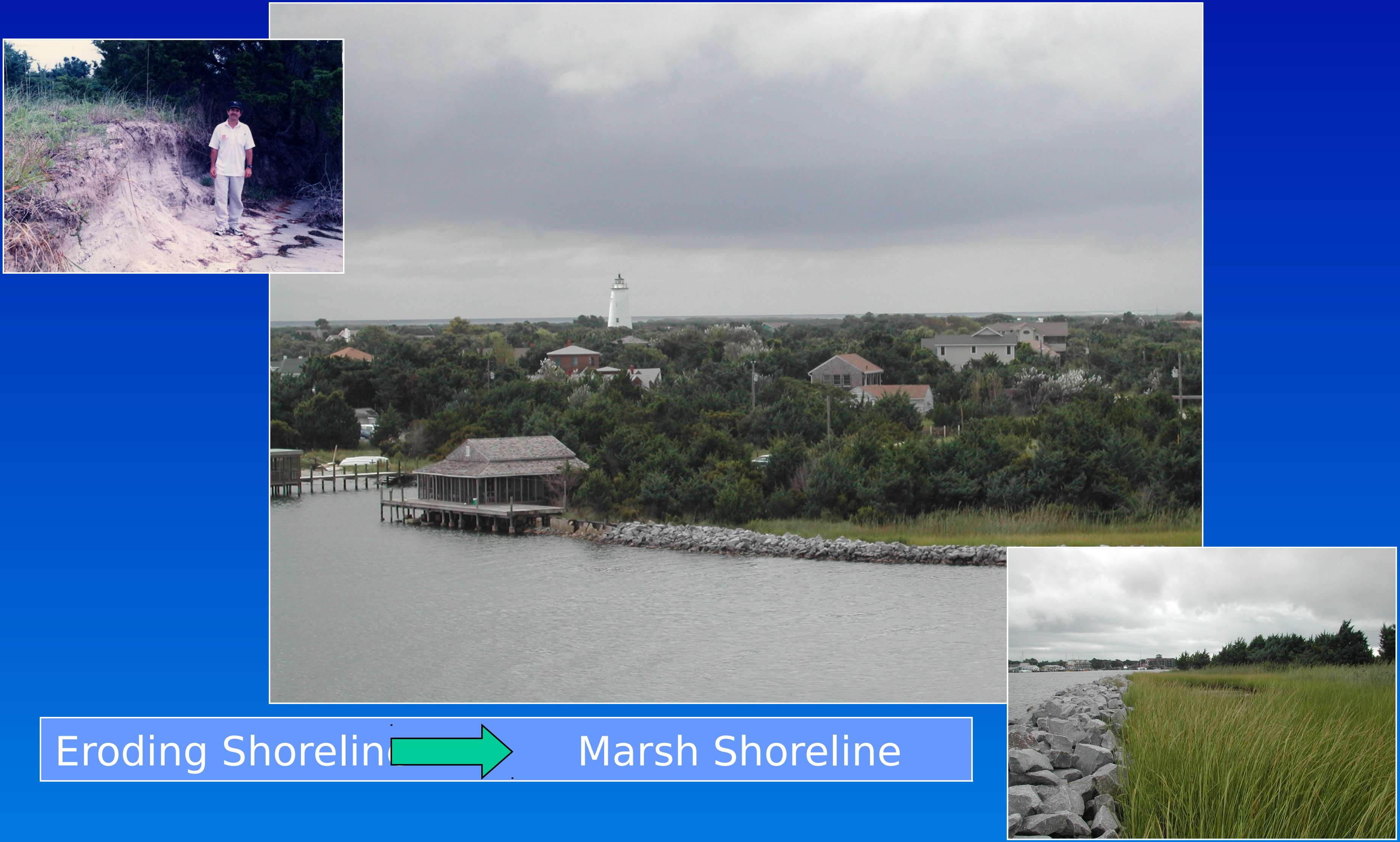
- Planting
  - Methods (Transplants or Seeding)
  - Logistic Considerations
    - Local Genotypes
    - No NC vendors
    - Native transplants concern especially for mitigation

Duck Shoreline Planting


1980
2003
~1981 - 1996
6 12 96
Duck
Pier
1997

Silver Lake Harbor

Jetty Extension & Marsh Planting

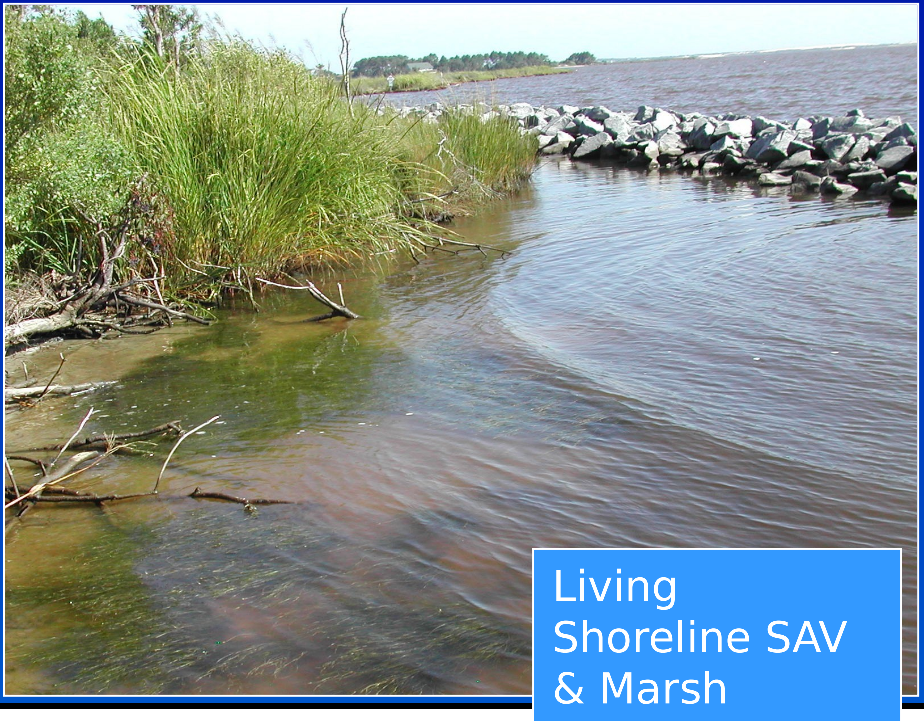


Eroding Shoreline → Marsh Shoreline

Festival Park Shoreline Restoration

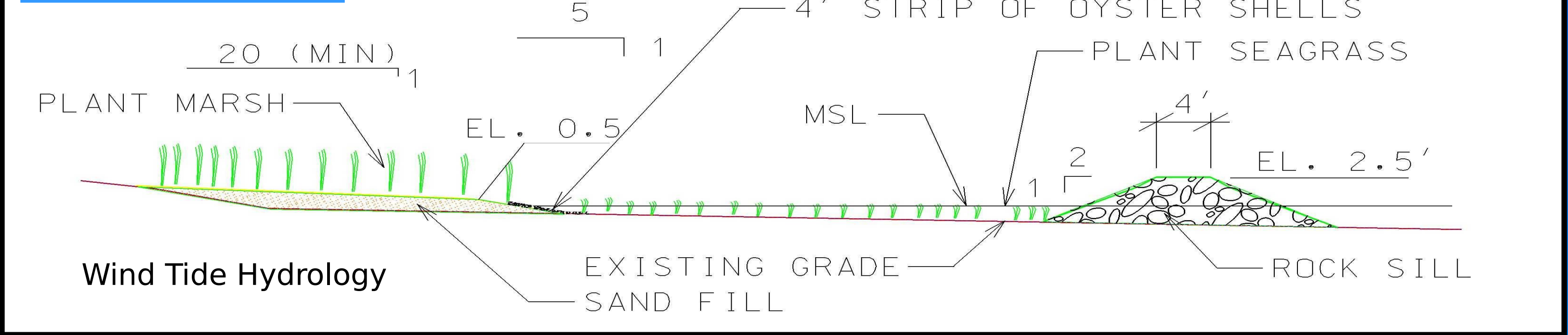
Remove Stressor and Allow Natural Colonization

Maritime Forest



Living Shoreline SAV & Marsh

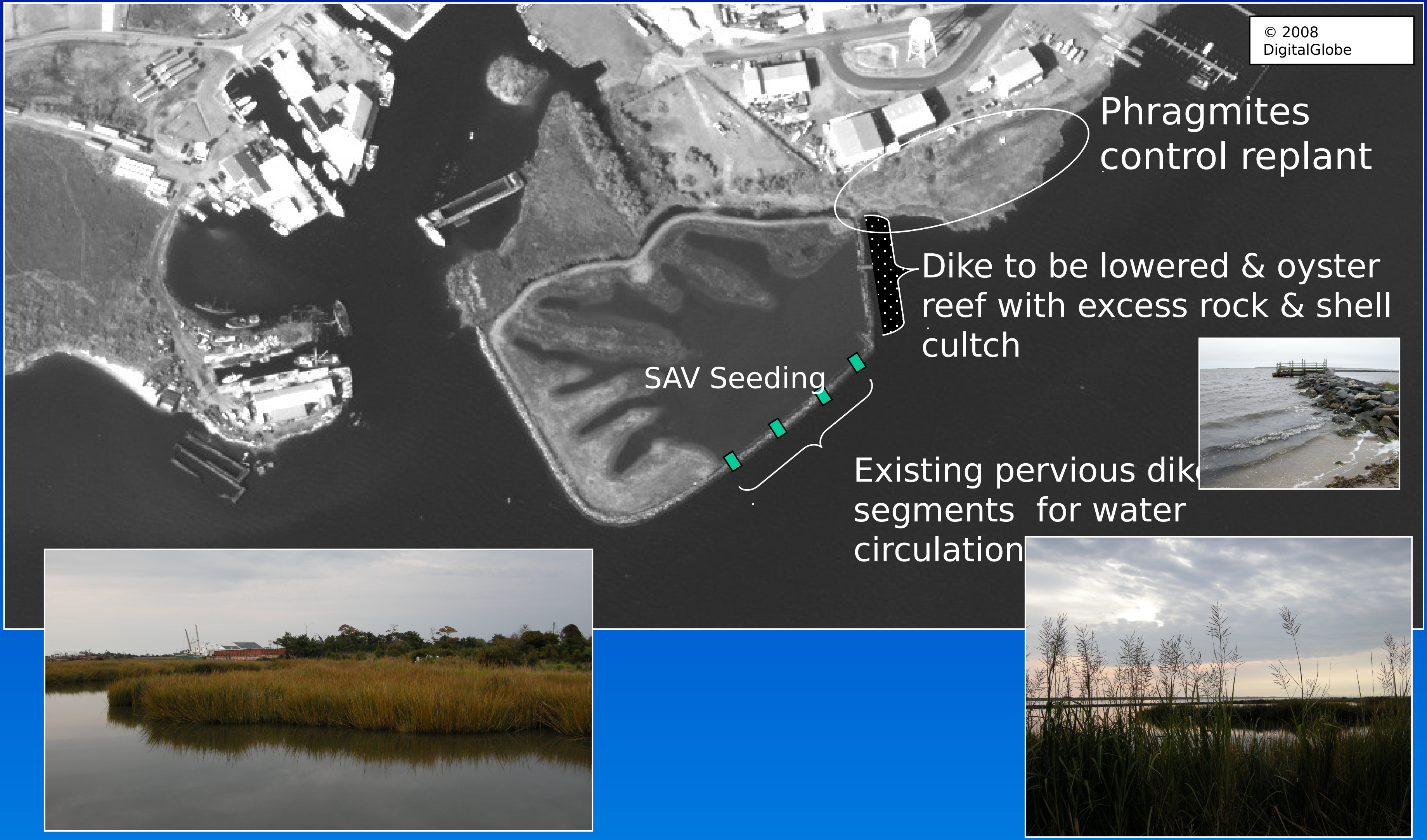
Oyster Reef


4' STRIP OF OYSTER SHELLS
5
1
PLANT SEAGRASS
20 (MIN)
1
PLANT MARSH
4'
EL. 0.5
MSL
2
1
EL. 2.5'
EXISTING GRADE
SAND FILL
ROCK SILL

Wind Tide Hydrology

Wanchese Marsh Creation

Beneficial use of Dredged Material



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Phragmites control replant

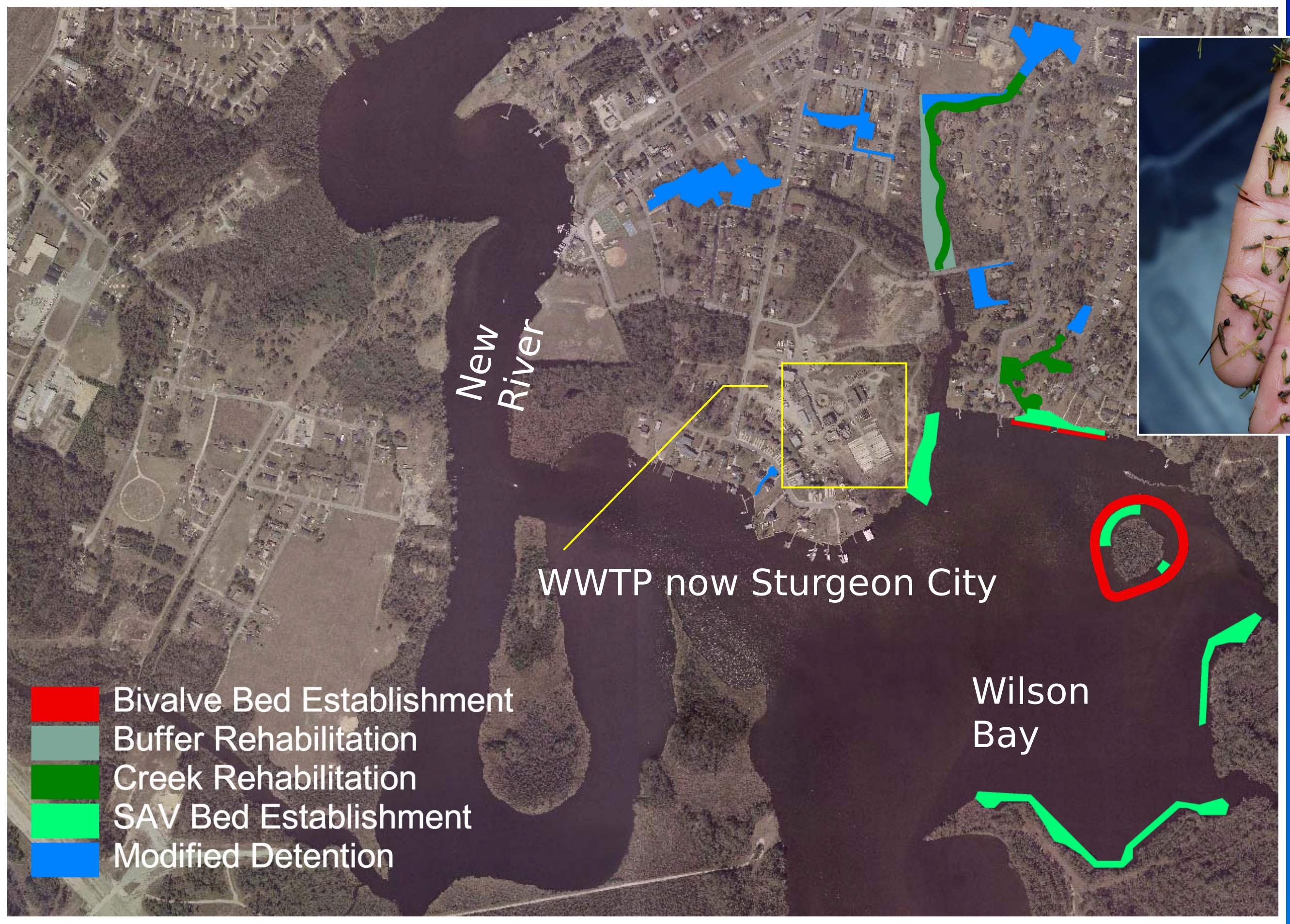
Dike to be lowered & oyster reef with excess rock & shell cultch

SAV Seeding

Existing pervious dik segments for water circulation

Wilson Bay Ecosystem Restoration

Remove Stressors and Plant Seeds and Plugs


New River
WWTP now Sturgeon City
Wilson Bay
🟥 Bivalve Bed Establishment
🟩 Buffer Rehabilitation
🟩 Creek Rehabilitation
🟩 SAV Bed Establishment
🟦 Modified Detention

Wilson Bay *Ruppia maritima* Seed Harvest and Production

Collect Seed Bearing Stems (Summer Year 1)

Floating Bags Deployed (Summer Year 1)

Isolate Seeds (Summer Year 1)

AACC Testing/Cold Storage (Summer/Winter Year 1)

Containers to Sturgeon City (Spring Year 2)

Broadcast Seeds (2 seeds/SF) (Spring Year 2)

Plant seeds in peat pots in drying beds and then transplant (Year 2)

3 week collection window (ERDC Photo)

Photo Credit Dr Ailstock AACC

Wilson Bay Ecosystem Restoration

SEED COLLECTION & PROCESSING

Currituck Sound

Refrigerated Truck

Sturgeon City

Seed Dispersal

Photo by MDDNR

Photo by VIMS

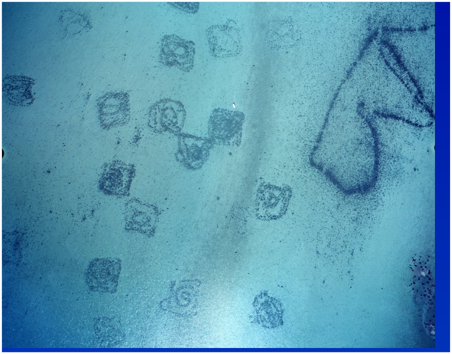
Seed Buoys (“Pickerell bags”) Pickerell et al 2005; 2006)

Pros: Mimics natural dispersal patterns, low cost, low tech, no expensive seed separation and storage required, avoids potential problems with seed mortality in storage, and swell-suited to volunteer labor

Cons: very labor intensive over short duration, transport logistics, permitting for large deployments can be challenging

Seed Planting

Seed Broadcasting : Eelgrass seed broadcasting effective seeds rapidly incorporate & do not move far from where they settle (Orth et al. 1994).



Manual Seed Broadcasting: low tech, low cost slow, even seed distribution difficult to achieve

Photo by VIMS

Mechanized Seed Broadcasting: capable of evenly dispersing seeds at suitable densities (100,000 - 300,000 seeds/acre) at the rate of 10 minutes/acre.

Photo by MDDNR

Slide adapted from Shafer ERDC

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